

AUG 1-0 2005



PATENT

Case Docket No. ASA-1162

In RE application of A. SATOYAMA et al.

Serial No.: 10/766,823

Group Art Unit: 2188

Filed: January 30, 2004

Examiner: M. PADMANABHAN

For: STORAGE SYSTEM AND REPLICATION CREATION METHOD THEREOF

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Transmitted herewith is an Amendment in the above-identified application.

- ☐ Small entity status of this application under 37 CFR 1.9 and 1.27 has been established by a verified statement previously submitted.
- ☐ A verified statement to establish small entity status under 37 CFR 1.9 and 1.27 is enclosed.
- ☐ No additional fee is required.

The fee has been calculated as shown below:

(COL. 1)		(COL. 2)		(COL. 3)
	Claims Remaining After Amendment		Highest No. Previously Paid For	Present Extra
Total	* 20	Minus	** 20	= 0
Indep.	* 2	Minus	*** 2	= 0
<input type="checkbox"/> First Presentation of Multiple Dependent Claims				

SMALL ENTITY	
Rate	Additional Fee
x 9	\$
x 42	\$
+ 140	\$
Total	\$

OTHER THAN A SMALL ENTITY	
Rate	Additional Fee
x 18	\$ 0
x 84	\$ 0
+ 280	\$ 0
Total	\$ 0

- \* If the entry in Col. 1 is less than the entry in Col. 2, write '0' in Col. 3.
- \*\* If the 'Highest Number Previously Paid For' IN THIS SPACE is less than 20, write '20' in this space.
- \*\*\* If the 'Highest Number Previously Paid For' IN THIS SPACE is less than 3, write '3' in this space.
- The 'Highest Number Previously Paid For' (Total or Independent) is the highest number found from the equivalent box in Col. 1 of a prior Amendment or the number of claims originally filed.

- ☐ Please charge my Deposit Account No. 50-1417 in the amount of \$ \_\_\_\_\_.
- ☒ A check in the amount of \$ 130.00 is attached in payment of:  
**CREDIT CARD FORM FOR PETITION TO MAKE SPECIAL FEE.**
- ☒ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 50-1417.
- ☒ Any filing fees under 37 CFR 1.16 for the presentation of extra claims.
- ☒ Any patent application processing fees under 37 CFR 1.17.
- ☒ Any Extension of Time fees that are necessary, which are hereby requested if necessary.

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THE UNITED STATES PATENT AND TRADEMARK OFFICE

**Appl. No. :** 10/766,823 **Confirmation No.** 3128  
**Applicant :** SATOYAMA, A. et al.  
**Filed :** January 30, 2004  
**Title :** STORAGE SYSTEM AND REPLICATION  
CREATION METHOD THEREOF  
**TC/AU :** 2188  
**Examiner :** M. Padmanabhan  
**Docket No. :** ASA-1162  
**Customer No.:** 24956

**PETITION TO MAKE SPECIAL**  
**(ACCELERATED EXAMINATION UNDER MPEP § 708.02(VIII))**

**MAIL STOP PETITIONS**  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

The Applicants petition the Commissioner to make the above-identified application special in accordance with 37 CFR §1.102(d). In support of this Petition, pursuant to MPEP § 708.02(VIII), Applicants state the following.

**(A) REQUIRED FEE**

This Petition is accompanied by the fee set forth in 37 CFR § 1.117(h).

Payment of the fee has been made in the manner set forth below in Section (G).

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**(B) ALL CLAIMS ARE DIRECTED TO A SINGLE INVENTION**

Claims 1-20 are pending in the application. All the pending claims of the application are directed to a single invention. If the Office determines that all claims in the application are not directed to a single invention, Applicant will make election without traverse as a prerequisite to the grant of special status in conformity with established telephone restriction practice.

The claimed invention, as set forth in independent claims 1 and 11, is generally directed to replication of volumes in storage systems. Under independent claim 1, the invention is a storage system comprising: a plurality of control units each connected with a plurality of disk units, each of the plurality of the control units including a plurality of replication creation units corresponding to the plurality of the control units, respectively, each of the replication creation units being adapted to create a replication of the data of the volume in the disk unit connected with the corresponding control unit; and a plurality of volume pair information corresponding to the plurality of the control units, respectively, each of the volume pair information designating an original volume and a replication volume, wherein the replication creation unit of a first control unit operates in such a manner that in the case where a replication is created in the volume in the disk unit connected to a first control unit, the volume information of the original volume and the volume information of the replication volume are registered in the volume pair information, and a replication is created in the volume in the disk unit connected to the first control unit based on the volume pair information, and in the case where a replication is created in the volume

in the disk unit connected to a second control unit, the volume information of the original volume, the volume information of the replication volume and the information on the second control unit are registered in the volume pair information, and a request to create a replication is transmitted to the second control unit based on the volume pair information.

Additionally, under independent claim 11, the invention is a method of creating a replication in a storage system including a plurality of control units each connected with a plurality of disk units, comprising the steps of: registering in a first control unit the original volume information and the replication volume information as the volume pair information, in the case where a replication of the data of the volume in the disk unit connected to the first control unit is created in the first control unit; registering in the first control unit the original volume information, the replication volume information in the first control unit and the information on the second control unit as the volume pair information of the first control unit, in the case where a replication of the data of the volume in the disk unit connected to the first control unit is created in the volume of the disk unit connected to the second control unit; generating in the first control unit a replication of the volume in the disk unit connected to the first control unit, based on the volume pair information, in the case where a replication of the data of the volume in the disk unit connected to the first control unit is created in the volume in the disk unit connected to the first control unit; and sending from the first control unit a replication creation request to the second control unit based on the volume pair information, in the case where a replication of the data of the volume in

the disk unit connected to the first control unit is created in the volume of the disk unit connected to the second control unit.

**(C) PRE-EXAMINATION SEARCH**

A pre-examination search has been conducted, directed to the invention as claimed. The pre-examination search was conducted in the following US Manual of Classification areas:

<u>Class</u>	<u>Subclass</u>
707	202-205
709	213, 216, 218, 220, 249
711	111-114, 118, 148, 153, 161, 162, 165, 170
714	5-7

Furthermore, a keyword search was conducted on the USPTO's EAST database, including the US patent database, the published patent applications database, and the European and Japanese patent abstract databases. In addition, a search for non-patent literature was conducted on the ACM (Association for Computing Machinery) online databases.

Additionally, it is noted that a search has also been conducted by an examiner in the European Patent Office, and the results of the European Search Report are listed below.

**(D) REFERENCES DEEMED MOST-CLOSELY RELATED TO THE SUBJECT MATTER ENCOMPASSED BY THE CLAIMS**

Based upon a review of the documents located by the search and the documents already of record in the application, the references deemed to be most-

closely related to the subject matter encompassed by the claims are listed below.

These documents were made of record in the present application by the Information Disclosure Statement filed on June 22, 2005.

<b><u>Document No.</u></b>	<b><u>Inventor</u></b>
US 5210866	Milligan et al.
US 5403639	Belsan et al.
US 5459857	Ludlam et al.
US 6073209	Bergsten
US 6131148	West et al.
US 6567774	Lee et al.
US 6606690	Padovano
US 6883073	Arakawa et al.
US 20030204572	Mannen et al.

Additionally, the following documents were cited in a European Search Report issued on March 30, 2005, by an examiner in the European Patent Office. All three of these references were cited as category "A" documents, i.e., "technological background". These documents were also made of record in the present application by the Information Disclosure Statement filed June 22, 2005.

<b><u>Document No.</u></b>	<b><u>Inventor</u></b>
US 20020129214	Sarkar et al.
US 20030131207	Arakawa et al.
EP 1217523	Nakamura et al.

Because all of the above-listed documents are already of record in the present application, in accordance with MPEP § 708.02(VIII)(D), additional copies of these documents have not been submitted with this Petition.

**(E) DETAILED DISCUSSION OF THE REFERENCES**

Following a brief discussion of the invention, the references deemed most-closely related are discussed below in Section (E)2, pointing out, with the particularity required by 37 CFR 1.111 (b) and (c), how the claimed subject matter is patentable over the teachings of these documents.

**1. Discussion of the Invention**

Under the invention, a storage system includes a plurality of control units that are each connected to a plurality of disk units, such that a copy of a storage area can be produced without attention being paid to the difference between control units, even in the case where a replication volume is created in disk units connected to different control units, as well as in disk units connect to the same control unit.

As set forth in independent claims 1 and 11, volume pair information designates an original volume and a replication volume. In the case where replication is created in a volume in a disk unit connected to a first control unit, the volume information of the original volume and the replication volume are registered in the volume pair information. In the case where replication is created in a volume in a disk unit connected to a second control unit, the volume information of the original volume, the volume information of the replication volume, and the information on the second control unit are registered in the volume pair information. This enables a request to create replication to be sent to the second control unit based upon the volume pair information.

As set forth in claim 1, a feature of the invention includes that, in the case where a replication is created in a volume in a disk unit connected to a second control unit, volume information of the original volume, volume information of the replication volume and information on the second control unit are registered in the volume pair information, and a request to create a replication is transmitted to the second control unit based on the volume pair information.

Similarly, as set forth in claim 11, a second feature of the invention includes registering in a first control unit original volume information, replication volume information in the first control unit and information on a second control unit as volume pair information of the first control unit, in the case where a replication of the data of the volume in the disk unit connected to the first control unit is created in a volume of a disk unit connected to the second control unit, and sending from the first control unit a replication creation request to the second control unit based on the volume pair information.

As will be discussed in more detail below, the prior art does not teach or suggest, at a minimum, the above-described features.

## **2. Discussion of the References Deemed to be Most-Closely Related**

The patent to Milligan et al., US 5210866, discloses a parallel disk drive array data storage subsystem that consists of three abstract layers: virtual, logical and physical. The virtual layer functions as a conventional large form factor disk drive memory. The logical layer functions as an array of storage units that are grouped



into a plurality of redundancy groups (ex 122-1 to 122-n+m), each containing N+M disk drives to store N physical tracks of data and M physical tracks of redundancy information for each logical track. The physical layer functions as a plurality of individual small form factor disk drives. The data storage management system operates to effectuate the mapping of data among these abstract layers and to control the allocation and management of the actual space on the physical devices. These data storage management functions are performed in a manner that renders the operation of the parallel disk drive array data storage subsystem transparent to the host processors. (See, e.g., Abstract and column 11, lines 47-64.) However, unlike the present invention, Milligan et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The patent to Belsan et al., US 5403639, discloses a file server system that creates and manages copies of data made external to a host processor. This file server system appears to the host computer to be a plurality of data storage devices which are directly addressable by the host computer using the native data management and access structures of the host computer. The file server however is an intelligent data storage subsystem that defines, manages and accesses synchronized sets of data and maintains these synchronized sets of data external

from the host computer system's data management facilities in a manner that is completely transparent to the host computer. This is accomplished by the use of the snapshot application data group that extends the traditional sequential data set processing concept of generation data groups. (See, e.g., Abstract and column 2, line 2, through column 3, line 10.) However, unlike the present invention, Belsan et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The patent to Ludlam et al., US 5459857, discloses a pair of operationally independent disk drive array data storage subsystems that are used to emulate one or more physical devices shared between two control modules. The storage control units of the two data storage subsystems are interconnected by at least one data link to exchange control and data signals between them. The storage control units of both data storage subsystems are synchronized to maintain identical virtual device images of certain assigned virtual devices both of the data storage subsystems where the duplicated data records of the single virtual device are stored. The data records are therefore stored in available memory on both of the two data storage subsystems. Data is exchanged over the data link to maintain consistency of the two sets of mapping tables. (See, e.g., Abstract, column 1, line 60, through column 2, line 44, and column 7, line 64, through column 8, line 41.) However, the mapping

tables of Ludlam et al. merely contain information such as a virtual track directory, and do not contain the information or perform the function of the volume pair information of the present invention, such as designating information on a second control unit if replication is to be created in a disk unit connected to a second control unit. Thus, unlike the present invention, Ludlam et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The patent to Bergsten, US 6073209, discloses a computer network that controls the data flow between one or more host processing systems and one or more data storage subsystems. The computer network comprises a number of storage controllers, each coupled to one of a plurality of storage arrays, each storage array including at least one mass storage device. Each storage controller may be coupled to at least one host processing system and to at least one other storage controller to control access of the host processing systems to the mass storage devices. Multiple copies of data are maintained in storage arrays that are geographically remote to each other, such that any copy can be accessed by any host. Each of the storage controllers includes an interface with a host that emulates a mass storage device and an interface with a local storage array that emulates a host. The interfaces to the host and local storage arrays are independent of the type

of host or devices in the local storage array. Two or more hosts may be dissimilar to each other, and two or more storage arrays may include dissimilar mass storage devices. Hosts access stored data using virtual addressing. During a data access, the storage controller connected to the accessing host maps a virtual address provided by the host to a real physical location in any of the storage arrays, such that the actual location of the data is transparent to the host. The storage controllers provide automatic back-up and error correction as well as write protection of back-up copies. (See, e.g., Abstract, column 1, lines 54-68, and column 5, line 23, through column 6, line 21.) However, unlike the present invention, Bergsten does not teach the use of registered volume pair information that may include a second control unit for transmitting a request for replication to the second control unit. More particularly, Bergsten does not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The patent to West et al., US 6131148, discloses a method and apparatus for snapshot copying of a volume of a data-storage system which employs remote dual copying techniques between a primary storage subsystem and a remote secondary storage subsystem and, more specifically, to the performance of an equivalent of a snapshot copy of a volume in a primary storage system at a remote secondary data-storage system. The method and apparatus includes setting up a Peer-to-Peer

Remote Copy (PPRC) session and snapshot copying a remote secondary volume to another volume on the remote subsystem. The apparatus includes a primary storage subsystem having a primary data-storage device with at least a primary volume. A primary processing unit relays a request to perform a snapshot copy of at least a portion of the primary volume to a secondary storage subsystem. The secondary storage subsystem includes a secondary data-storage device having a secondary volume which is maintained in a duplexed state with the primary volume through the use of remote copy sessions. A secondary processing unit, responsive to the relayed request can perform an equivalent of a snapshot copy of at least a portion of the primary volume by making a snapshot copy of a corresponding portion of the secondary volume. (See, e.g., Abstract and column 2, lines 21-60.) However, unlike the present invention, West et al. do not disclose registered volume pair information including information on a second control unit. More particularly, West et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The patent to Lee et al., US 6567774, discloses a system for configuring and updating the configuration of networked client stations, comprising: one or more storage devices including respective configuration information for configuring client stations connected via a network to each other and to the one or more storage disk

devices, where each of the client stations is configurable with respective configuration information. One or more virtual disks respectively contains configuration information identifiers, each including a representation of respective configuration information and mapping information pointing to corresponding one or more of the locations in the storage devices where the respective configuration information is stored. A logical copy of each of the one or more virtual disks from which a second virtual disk is respectively created for updating the configuration of any of the client stations; where each of the client stations obtains respective configuration information with the one or more virtual disks and the configuration information identifiers, and each client station obtains an updated version of the configuration information with the second virtual disk. (See, e.g., Abstract and column 1, line 59, through column 2, line 46.) However, unlike the present invention, Lee et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The patent to Padovano, US 6606690, discloses a method, system, and apparatus for accessing a plurality of storage devices in a storage area network (SAN) as network attached storage (NAS) in a data communication network. A SAN server includes a first interface and a second interface. The first interface is configured to be coupled to the SAN. The second interface is coupled to a first data

communication network. A NAS server includes a third interface and a fourth interface. The third interface is configured to be coupled to a second data communication network. The fourth interface is coupled to the first data communication network. The SAN server allocates a first portion of the plurality of storage devices in the SAN to be accessible through the second interface to at least one first host coupled to the first data communication network. The SAN server allocates a second portion of the plurality of storage devices in the SAN to the NAS server. The NAS server configures access to the second portion of the plurality of storage devices to at least one second host coupled to the second data communication network. In one embodiment, the NAS servers appear as separate hosts to the SAN servers. The SAN servers allocate storage to the NAS servers. In turn, the NAS servers allocate the storage to the second network. For instance, storage may be allocated in the form of logical unit numbers (LUNs) to the NAS servers. According to the embodiment, the NAS server LUNs are virtualized on the second network, instead of being dedicated to a single host. Thus, the SAN appliance can export LUNs to the entire second network. (See, e.g., Abstract and column 4, line 66, through column 5, line 39.) However, unlike the present invention, Padovano does not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The patent to Arakawa et al., US 6883073, (also published as US20030131207, cited in the European search report) discloses a computer system and a method for controlling information processing system which creates a virtualized volume snapshot, a computer system and storage device control method and a storage device. A server has management information including correspondence information between a physical storage region and a virtualized storage region, so as to provide a virtualized storage region. The server includes a unit for using the management information to provide a virtualized storage region to another host and a unit for instructing the control of the storage regions based on the virtualized storage region to a controller for a storage device for providing the physical storage region. Moreover, the controller includes a unit having whole or a part of management information including the correspondence information and performing the control of the storage device based on the virtualized storage region in response to the instruction. Mapping information may include volume number, volume size, device number, and snapshot attribute. (See, e.g., Abstract, column 2, line 66, through column 3, line 52, and column 7, line 48, though column 8, line 36.) However, unlike the present invention, Arakawa et al. do not include volume pair information including information on a second control unit to which a request to create replication may be transmitted. More particularly, Arakawa et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request



to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The published patent application to Mannen et al., US 20030204572, discloses a method for creating a copy of a virtualized storage region in a data processing system for virtualizing the storage region. A server manages the correlation between the virtualized storage region and the physical storage region, utilizes the function of the storage unit for those physical storage regions having a function, and the function for those physical storage regions without the function, to efficiently copy the virtualized storage region. The computer system for realizing the virtualization may be connected to any type of storage unit systems. FIG. 7 illustrates an example of pair state data. Pair state data is a table in which data pairs are registered at the time data is copied, such as by snapshot, i.e., a table in which data are registered data that represent a relationship between the virtualized volume at the copy source and the virtualized volume at the copy destination. The pair number represents a pair of virtualized volumes, one at the copy destination and the other at the copy source managed by server. As shown, there may be only one virtualized volume at the copy source and a plurality of virtualized volumes at the copy destination. The copy source volume represents the number of the virtualized volume at the copy source. The copy destination volume represents the number of the virtualized volume at the copy destination. (See, e.g., Abstract and paragraphs 62 and 65, and Figure 7.) However, unlike the present invention, Mannen et al. do

not disclose a volume pair information that includes information on a second control unit designated in the volume pair information. More particularly, Mannen et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

The European patent application to Nakamura et al., EP 1217523, shows a method and apparatus for re-synchronizing paired disk volumes via a communication line. A storage system duplication method is taught for copying data from a plurality of logical volumes in a first storage system to a second storage system. Primary and secondary volumes are paired, and the paired logical volumes may be recreated based upon stored pair information. (See, e.g., Abstract and paragraphs 13-14 and 38-47.) However, Nakamura et al. do not teach the use of information on a second control unit in volume pair information. More particularly, Nakamura et al. do not disclose registered volume pair information designating an original volume, a replication volume, and information on a second control unit, for enabling a request to create replication to be sent to the second control unit based upon the volume pair information, as set forth in claims 1 and 11.

## **CONCLUSION**

As demonstrated by the above discussion, the references fail to teach or suggest, at a minimum, that, in the case where a replication is created in a volume in a disk unit connected to a second control unit, volume information of the original volume, volume information of the replication volume and information on the second control unit are registered in the volume pair information, and a request to create a replication is transmitted to the second control unit based on the volume pair information, as set forth in claim 1.

The references also fail to teach or suggest, at a minimum, registering in a first control unit original volume information, replication volume information in the first control unit and information on a second control unit as volume pair information of the first control unit, in the case where a replication of the data of the volume in the disk unit connected to the first control unit is created in a volume of a disk unit connected to the second control unit, and sending from the first control unit a replication creation request to the second control unit based on the volume pair information, as recited in claim 11.

The Applicants submit that the foregoing discussion demonstrates the patentability of the independent claims over the closest-known prior art, taken either singly, or in combination. The remaining claims depend from the independent claims, claim additional features of the invention, and are patentable at least because they depend from allowable base claims. Accordingly, the requirements of 37 CFR §1.102(d) having been satisfied, the Applicants request that this Petition to

Make Special be granted and that the application be examined according to prescribed procedures set forth in MPEP §708.02 (VIII).

The Applicants prepared this Petition in order to satisfy the requirements of 37 C.F.R. §1.102(d) and MPEP §708.02 (VIII). The pre-examination search required by these sections was “directed to the invention as claimed in the application for which special status is requested.” MPEP §708.02 (VIII). The search performed in support of this Petition is believed to be in full compliance with the requirements of MPEP §708.02 (VIII); however, Applicants make no representation that the search covered every conceivable search area that might contain relevant prior art. It is always possible that prior art of greater relevance to the claims may exist. The Applicants urge the Examiner to conduct his or her own complete search of the prior art, and to thoroughly examine this application in view of the prior art cited above and any other prior art that may be located by the Examiner’s independent search.

Further, while the Applicants have identified and discussed certain portions of each cited reference in order to satisfy the requirement for a “detailed discussion of the references, which discussion points out, with the particularity required by 37 C.F.R. §1.111(b) and (c), how the claimed subject matter is patentable over the references” (MPEP §708.02(VIII)), the Examiner should not limit review of these documents to the identified portions, but rather is urged to review and consider the entirety of each reference.

**(G) FEE PAYMENT (37 C.F.R. 1.17(h))**

The fee required by 37 C.F.R. § 1.17(h) is to be paid by:

☒ the Credit Card Payment Form (attached) for \$130.00.

☐ charging Account 50-1417 the sum of \$130.00.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of MATTINGLY, STANGER, MALUR & BRUNDIDGE, P.C., Deposit Account No. 50-1417. A duplicate of this petition is attached.

Respectfully submitted,



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Date: August 10, 2005